

We claim:

1. A surgical extractor for removing tissue from an animal or human body cavity, the extractor comprising:

5 a body having a leading end, a trailing end, a longitudinal axis, and a lumen between said leading and trailing ends, said lumen including a seal adapted to permit the passage of a surgical instrument therethrough while inhibiting the loss of pressure from within the cavity when the surgical extractor is in contact with the cavity; and

10 a dilator at the leading end of said body being movable between an unexpanded position and an expanded position.

2. The surgical extractor of claim 1, wherein said seal is a two-part seal.

15 3. The surgical extractor of claim 2, wherein said seal has a first part that seals said lumen when the surgical instrument is inserted into said lumen and a second part that seals said lumen when the surgical instrument is removed from said lumen.

20 4. The surgical extractor of claim 3, wherein said second seal has a through-hole smaller than the maximum cross sectional dimension of the surgical instrument.

5. The surgical extractor of claim 1, wherein said body has a maximum cross sectional dimension along a portion of said body adapted to be inserted into the

body cavity and said dilator has a maximum cross sectional dimension in the expanded position that is greater than the maximum cross sectional dimension of said body.

5 6. A method for aspirating material from an animal or human body cavity, the method comprising the steps of:

 inserting an instrument adapted to manipulate the tissue through the body cavity, the instrument having a passage therein; and

 suctioning fluid from the tissue through the passage of the instrument.

10 7. The method of claim 6, further comprising the step of grasping the tissue with the instrument to remove the tissue from the cavity.

15 8. The method of claim 6, further comprising the step of treating the tissue to at least partially dissolve the tissue or any contents in the tissue.

 9. The method of claim 8, wherein the treating step includes the sub-step of treating the tissue with methyl tert-butyl ether.

20 10. The method of claim 6, further comprising the step of inserting a cannula into the cavity, the cannula having a lumen adapted to accept the instrument.

11. The method of claim 8, wherein the treating step is performed through the passage of the instrument.

12. The method of claim 6, further comprising the step of dilating the cavity to remove tissue that is unable to fit completely within the cannula without substantial compression of the tissue.

13. The method of claim 12, wherein the dilating step is performed by the instrument.

14. The method of claim 13, wherein the instrument is a surgical extractor having a dilator.

15. The method of claim 6, wherein the suctioning step includes the step of suctioning bile from a gall bladder.

16. The method of claim 6, wherein the inserting step includes the step of inserting a cannula having a maximum diameter in the range of 3 mm to 5 mm.

17. The method of claim 6, further comprising the step of removing the tissue from the cavity.

18. A method for removing tissue from an animal or human body cavity that is unable to fit completely within a cannula without substantial compression, the method comprising the steps of:

inserting the cannula into the cavity;

inserting a dilator having a leading end through the cannula;

expanding the leading end of the dilator to an expanded position;

inserting a grasper through the dilator;

grasping the tissue with the grasper;

moving the tissue with the grasper into the dilator; and

dilating the cavity to remove the tissue.

19. The method of claim 18, further comprising step of retaining the tissue within the expanded leading end of the dilator.

20. The method of claim 19, further comprising the step of removing the cannula with the dilator remaining substantially in the expanded position.

21. The method of claim 18, further comprising the step of suctioning fluid or other material from the tissue.

22. The method of claim 21, wherein the suctioning step includes the step of suctioning bile or other material from a gall bladder.

23. The method of claim 18, wherein the leading end of the dilator includes a draw cable for drawing in the leading end of the dilator, further comprising the step of pulling the draw cable to draw in the leading end of the dilator.

5 24. The method of claim 23, further comprising the step of removing the cannula with the dilator remaining substantially in the expanded position.

25. The method of claim 18, wherein the step of inserting the cannula includes inserting a cannula having a maximum diameter in the range of 3 mm to 5 mm.

26. A surgical tool set for removing tissue from an animal or human body cavity, said tool set comprising:

a surgical extractor dilator having a leading end, a trailing end, a length therebetween, and a lumen between the leading and trailing ends, said leading end having a dilator movable between an unexpanded position and an expanded position; and

a grasper insertable within said lumen of said surgical extractor dilator, said grasper having a leading end with grasping surfaces, a trailing end with a handle, and a lumen between the leading and trailing ends, said lumen of said grasper adapted to permit the passage of a surgical instrument therethrough, said grasper having a length greater than the length of said surgical extractor dilator.

27. The surgical tool set of claim 26, further comprising an elongated needle adapted to be inserted within said lumen of said grasper, said needle having a length sufficient to extend beyond a distal end of said grasper.

5 28. The surgical tool set of claim 27, wherein said needle is adapted to be connected to a syringe.

29. The surgical tool set of claim 27, wherein said needle is adapted to be connected to an aspirator.

10 30. The surgical tool set of claim 26, further comprising a cannula for providing protected access to a surgical site, said cannula having a leading end, a trailing end, a length therebetween, and a lumen between the leading and trailing ends adapted to permit passage of said surgical extractor dilator therethrough.

15 31. The surgical tool set of claim 30, wherein said cannula has a maximum outer diameter less than 10 mm.

20 32. The surgical tool set of claim 31, wherein said cannula has a maximum outer diameter in the range of 3 mm to 5 mm.

33. The surgical tool set of claim 26, further comprising at least one seal oriented within said lumen of said surgical extractor dilator configured to permit the

passage of said grasper therethrough while inhibiting a loss of pressure from within the body cavity after said surgical extractor dilator is inserted in the patient.

34. The surgical tool set of claim 33, wherein said at least one seal has a through-hole smaller than the maximum cross sectional dimension of said grasper.

35. A surgical extractor for removing tissue from an animal or human body cavity, the extractor comprising:

a body having a leading end, a trailing end, a longitudinal axis, and a lumen between said leading and trailing ends;

a dilator at the leading end of said body being movable between an unexpanded position and an expanded position, said dilator having an inner surface; and

tissue retaining protrusions on said inner surface of said dilator, said tissue retaining protrusions being uniformly spaced around the longitudinal axis of said body.

36. The surgical extractor of claim 35, wherein said tissue retaining protrusions are teeth.

37. The surgical extractor of claim 35, wherein said tissue retaining protrusions are configured to generally point towards said trailing end of said body when said dilator is in the expanded position.

38. The surgical extractor of claim 35, wherein said tissue retaining protrusions are spaced substantially about the entire area of said inner surface.

5 39. The surgical extractor of claim 35, wherein said dilator includes a cell migration barrier formed between at least two different materials.

40. The surgical extractor of claim 39, wherein one of said materials is PTFE.

10 41. The surgical extractor of claim 39, wherein one of said materials is polyester.

15 42. The surgical extractor of claim 35, wherein said dilator includes a memory element configured to expand said dilator from the unexpanded position to the expanded position.

43. The surgical extractor of claim 42, wherein said memory element is along a circumference of said dilator.

20 44. The surgical extractor of claim 43, wherein said memory element is positioned at a leading end of said dilator.

45. The surgical extractor of claim 42, wherein said dilator includes memory elements parallel to the longitudinal axis when said dilator is in the unexpanded position.

5 46. The surgical extractor of claim 42, wherein said memory element is adapted to expand said leading end of said dilator to an angle of at least 10 degrees from the longitudinal axis of said surgical extractor.

10 47. The surgical extractor of claim 42, wherein said memory element is adapted to expand said leading end of said dilator to an angle of at least 20 degrees from the longitudinal axis of said body.

15 48. The surgical extractor of claim 35, further comprising a retainer around at least a portion of said dilator for maintaining said dilator in the unexpanded position, said retainer being adapted to be removed from said dilator, thereby allowing said dilator to move to the expanded position.

49. The surgical extractor of claim 35, wherein said dilator has a maximum diameter in the range of 3 mm to 5 mm in the unexpanded position.

20 50. The surgical extractor of claim 35, wherein said tissue retaining protrusions are formed from a memory element.

51. A surgical extractor for removing tissue from an animal or human body cavity, the extractor comprising:

a body having a leading end, a trailing end, a longitudinal axis, and a lumen between said leading and trailing ends; and

5 a dilator at the leading end of said body being movable between an unexpanded position and an expanded position, said dilator having an inner surface made substantially of a first material and an outer surface made substantially of a second material, said first material of said inner surface having a coefficient of friction greater than a coefficient of friction of said second material of said outer surface.

52. The surgical extractor of claim 51, wherein the coefficient of friction of said inner surface of said dilator is in a range from 0.5 to 0.9.

15 53. The surgical extractor of claim 51, wherein said dilator includes a cell migration barrier formed between at said first and second materials.

54. The surgical extractor of claim 51, wherein one of said materials is PTFE.

20 55. The surgical extractor of claim 51, wherein one of said materials is polyester.

56. The surgical extractor of claim 51, further comprising surface roughenings along said inner surface.

57. The surgical extractor of claim 51, further comprising protrusions adapted to grab tissue without penetrating the tissue.

58. A surgical extractor for removing tissue from an animal or human body cavity, the extractor comprising:

a body having a leading end, a trailing end, a longitudinal axis, and a lumen between said leading and trailing ends;

a dilator at the leading end of said body being movable between an unexpanded position and an expanded position; and

a retainer for restricting said dilator in the unexpanded position, said retainer being adapted to be removed from said dilator, thereby allowing said dilator to move to the expanded position.

59. The surgical extractor of claim 58, wherein said retainer comprises a polyurethane film.

60. The surgical extractor of claim 58, wherein said retainer includes a grip proximate said trailing end of said body for peeling open said retainer.

61. A surgical extractor for removing tissue from an animal or human body cavity of a patient, the extractor comprising:

a body having a leading end, a trailing end, a longitudinal axis, and a lumen between said leading and trailing ends;

5 a dilator at the leading end of said body being movable between an unexpanded position and an expanded position, said dilator having a leading end;

a cover at the leading end of said dilator adapted to capture the tissue prior to the extraction thereof from the patient; and

10 a draw cable running through said lumen of said body, and having at least one loop at the leading end of said cover, said draw cable being adapted to draw in said cover upon moving said draw cable away from the trailing end of said body.

62. The surgical extractor of claim 61, wherein said cover includes a hem enclosing at least a portion of said draw cable.

63. The surgical extractor of claim 61, wherein said draw cable is adapted to run from said cover through said lumen of said body and lie beyond said trailing end of said body.

20 64. The surgical extractor of claim 61, wherein said cover has a perimeter and a distal end of said draw cable is adapted to circumscribe the perimeter of said cover to form said at least one loop.

65. The surgical extractor of claim 64, wherein said draw cable is adapted to form a plurality of loops around the perimeter of said cover.

5 66. The surgical extractor of claim 61, wherein said cover is made from a breathable material.

67. The surgical extract of claim 61, wherein said cover is watertight.

10 68. A method for removing tissue from an animal or human body cavity, the method comprising the steps of:

inserting a cannula into the cavity;

inserting a dilator into the cannula, the dilator having a leading end with a cover attached thereto, the cover having a draw cable adapted to draw in the cover;

expanding the leading end of the dilator to an expanded position;

15 moving the tissue into the dilator; and

drawing the draw cable.

69. The method of claim 68, wherein the drawing step includes the step of drawing the draw cable to draw in the cover while the tissue is within the cavity.

20 70. The method of claim 68, further comprising the step of dilating the cavity to remove the tissue.

71. The method of claim 68, further comprising the steps of inserting a grasper through the cannula and grasping the tissue with the grasper to remove the tissue from the cavity.

5 72. The method of claim 68, wherein the draw cable has a distal end attached to the cover and a proximal end lying outside the cannula, the pulling step including the sub-step of pulling the proximal end of the draw cable to draw in the cover.

10 73. A method for removing tissue from an animal or human body cavity, the method comprising the steps of:

inserting a cannula into the cavity;

treating the tissue to at least partially dissolve the tissue or any contents in the tissue;

15 inserting a dilator having a leading end through the cannula;

expanding the leading end of the dilator to an expanded position;

inserting a grasper through the dilator;

grasping the tissue with the grasper;

moving the tissue into the dilator; and

20 dilating the cavity to remove the tissue therefrom.

74. The method of claim 73, wherein said treating step includes the sub-step of treating the tissue with methyl tert-butyl ether.

75. The method of claim 73, wherein said treating step is repeated prior to removing the tissue from the cavity.

5 76. The method of claim 73, wherein the tissue is a gall bladder, said treating step including the sub-step of partially dissolving at least one gallstone.

77. A grasper for grasping tissue, the grasper comprising:
a shaft having a trailing end, a leading end, and a lumen therebetween, said
10 lumen being configured to receive at least one surgical instrument;
at least two grasping surfaces at said leading end configured to grasp tissue therebetween; and
a handle at said trailing end configured to operate said grasping surfaces.

15 78. The grasper of claim 77, wherein said trailing end includes a depth-limiting protrusion for limiting the depth of insertion of said grasper into a cavity.

79. The grasper of claim 77, wherein said lumen has an inside maximum cross sectional dimension in the range of 1 mm to 4mm.

20 80. The grasper of claim 77, wherein said shaft has a length in the range of 15 cm to 35 cm.

81. The grasper of claim 77, wherein said shaft has an outside maximum cross sectional dimension of less than 5 mm.

5 82. The grasper of claim 77, further comprising at least a third grasping surface at said leading end.

83. The grasper of claim 77, wherein said grasping surfaces include ridges to grasp the tissue.

10 84. The grasper of claim 77, further comprising a seal oriented within said lumen of said grasper configured to permit the passage of a needle therethrough.

15 85. The grasper of claim 84, wherein said seal includes a through-hole having smaller than the maximum cross sectional dimension of the surgical instrument.

86. The grasper of claim 84, wherein said seal is adapted to inhibit a loss of pressure from within a patient after said grasper is inserted in the patient.

20 87. A method for removing tissue from an animal or human body cavity, the method comprising the steps of:

inserting a grasper having a passage into the body cavity;

suctioning fluid from the cavity through the passage of the grasper; and

grasping the tissue to remove the tissue from the cavity.

88. The method of claim 87, further comprising the step of inserting a cannula into the cavity.

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89. The method of claim 88, further comprising the steps of inserting a dilator having a leading end through the cannula and expanding the leading end of the dilator to an expanded position.

90. The method of claim 89, further comprising the step of removing the cannula with the dilator remaining substantially in the expanded position.

91. The method of claim 89, wherein the leading end of the dilator includes a draw cable for drawing in the leading end, further comprising the step of pulling the draw cable to draw in the leading end of the dilator.

92. The method of claim 89, further comprising the step of removing the cannula with the dilator remaining substantially in the expanded position.

93. The method of claim 88, wherein the step of inserting the cannula includes inserting a cannula having a maximum diameter in the range of 3 mm to 5 mm.

94. The method of claim 87, wherein the step of suctioning includes the step of suctioning bile or other material from a gall bladder.

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